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ABSTRACT

In this paper, the impacts of Electronic Commerce (EC) on the international marketing strategies of information service industries are studied. In seeking to blend humanistic concerns in this research with technological development by addressing challenges for deterministic attitudes, the paper examines critical environmental factors relevant to Internet commerce in changes in the international marketing environment from the viewpoints of business activity, socio-economics, and information management. The need for a new marketing paradigm for EC, which comes out of trends in international electronic marketing, is also examined. The impacts of EC for the information service industry are discussed, and a hierarchy fuzzy multicriteria decision-making (Fuzzy MCDM) method for evaluating the propagating EC market strategies is proposed. The process of evaluating the hierarchy strategies includes three steps: (1) assessing the weights of each strategic item; (2) getting the performance value of each strategic item from the sense of experts; and (3) evaluating the strategic items. Finally, in order to show the practicability and usefulness of this method, an example is taken as a verifiable method. From the results of practical applications in evaluating the electronic marketing strategies, the proposed method is appropriate and appears to be ideal for a fuzzy environment. (Contains 54 references.) (Author/MES)

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A HIERARCHY FUZZY MCDM METHOD FOR STUDYING ELECTRONIC MARKETING STRATEGIES IN THE INFORMATION SERVICE INDUSTRY

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In this paper the impacts of Electronic Commerce (EC) on the international marketing strategies for the information service industries are studied. In seeking to blend humanistic concerns in this research with technological development by addressing challenges for deterministic attitudes, it also examines critical environmental factors relevant to Internet commerce in the changes of the international marketing environment The needs for a new marketing paradigm for EC, which comes out of new trends of international electronic marketing, is also examined. The impacts of EC for the information service industry were discussed and a hierarchy fuzzy multicriteria decision-making (Fuzzy MCDM) method for evaluating the propagating EC market strategies is proposed. Finally, in order to show the practicability and usefulness in this method, an example is taken as a verifiable method. From the results of practical applications in evaluating the electronic marketing strategies, the proposed method is appropriate and appears to be ideal for a fuzzy environment.

INTRODUCTION

Since the Internet was built by the US government in the late 1960s, information and communication technologies of electronic commerce (EC) have shortened business transaction cycles in virtually every industry and fierce global competition has put a premium on sharing information among product designers, manufacturers, and distributors. Businesses must now compete in terms of service, quality and cost against an ever increasing list of rivals. However, the information products or services that can be delivered directly to the consumers via computer networks, not via physical distribution channels. Information service industries include computer software, electronic book, newspaper, magazine, movie, television, video game, picture, newsletter, and music industries. Broadly defined, EC is a modern business methodology that addresses the needs of merchants, organizations, and consumers to cut costs while improving the quality of goods and services and increasing the speed of service delivery (Kalakota and Whinston, 1996) for raising the efficiency and usefulness increasing the revenue. How EC influences the strategies of international marketing is of great importance for practical applications and academic researches. The study presented here analyzes the impact of EC on the international marketing environment, strategies, and future trends in the information service industry. The purpose of this study first focuses on exploring the properties of information service industries and related issues concerning business activity, socio-economics, information management. Then, through the analysis of the impacts of EC on the international marketing environment, we develop a conceptual model to explain the relationship among information infrastructure, EC, international marketing environment, and the new international marketing paradigm. Lastly, we examine the impacts of EC on trends in international marketing strategies. Streeter et al. (1996) apply multiple regression analysis to estimate the impacts of the Internet for customer (user) and for lifestyle change (society) on relationships of the efficiency, the service qualities and so on. Quelch and Klein (1996) examine the opportunities and challenges facing multinational corporations marketing decision making in the EC environment. In

IR 057396

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addition, Hoffman and Novak (1996) emphasize the importance of innovative marketing paradigms from the viewpoint of new media. Armstrong and Hagel (1996) suggest that creating on-line communities can strengthen the customer loyalty. From the viewpoint of business process reengineering (BPR), Lee and Clark (1997) analyze the opportunities and challenges caused by electronic market systems. Analysis of a specific industry, was done by Angehrn and Meyer (1997), who develop a strategic framework to thoroughly study the current strategic positions of the banking industry and explore future strategic trends, and by O'Reilly (1996), who discusses the publishing model for the Internet commerce. Therefore, based on the ideas of above literatures by using the concepts of multiattribute strategies for reengineering business process of information service industries, a hierarchy a hierarchy fuzzy multicriteria decision-making (Fuzzy MCDM) method for evaluating the propagating EC market strategies was proposed. Finally, in order to show the practicability and usefulness in this method, an example was taken as a verifiable method.

CHANGES IN THE ELECTRONIC MARKETING ENVIRONMENT

Historically, technological advances have affected in social and economic transformation on a vast scale. This has been especially true when new technologies have unfolded across space as well as time. Before analyzing the impact of EC on international marketing strategies, we must have an understanding of the changes in the international marketing environment from viewpoints of business activity, socio-economic, social behavior on culture and politics, and information types.

Business Activity

Change in Business Process. Kalakota and Whinston (1996) hold that EC is well suited to facilitate the reengineering of business processes occurring at many firms. The broad goals of reengineering and EC are remarkably similar: reduced costs, lower product cycle times, faster response to customer requests, and improved service quality. Lee and Clark (1997) use the viewpoint of business BPR to analyze the opportunities and challenges resulting from electronic market systems. Because all the products in information service industries can be presented in the forms of texts, graphs, sounds, images, pictures, videos, animations, and any other digital information, these digital products can be transmitted to customers through the Internet without the use of physical distribution channels for increasing and achieving the information value. According to the evolution process the information service industries in business process can be classified two stages.

Generic business processes of conventional information service industries. The generic business processes of conventional information service industries have built the concept between information service providers and customers (users). In this concept how the information service providers may deal with their promotion activities through advertising and promotion in media like TV, electronic newspapers, magazine, etc. These acquisition and communication channels include electronic documents, magnetic medium, facsimiles, emails, and telephone communications. Also, in the generic situation, the consumers must make contact with the product distribution channels and go to the markets in person to select and purchase the desired information products, such as computer software, books, newspapers, music CDs, movies, and video games. Consumers can either pay in cash or employ the electronic funds transfer to complete the payment procedures. The contents of the information service are usually provided by the creators of the information services.

Business process reengineering of information service industries. We provide the information for customer (users) in the business processes of information service industries, after the implementation of EC. The resulting BPR integrates all the value chains and international marketing activities of these industries. The EC environment involves the medium of promotions and advertising, transactions, customer communications, information product development, acquisitions, and services, international marketing researches, designs of pricing strategies, distribution channels, and electronic payment services. In addition, information service firms can employ the Internet to communicate with their international customers and information creators.

Change in Transaction Costs

The development of EC implies a change in transaction costs among corporations and consumers. The concept of "transaction costs" originally introduced by Coase (1937) includes search costs necessary to set up the minimum social unit for the exchange. This includes the costs to establish and operate information channels and decision processes. The theory of transaction costs is usually used to analyze the impact of information technology (IT) applications on organizational structures and strategic management. Malone, et al. (1987) use transaction cost theory to suggest that IT, by reducing transaction costs, will reduce forces for vertical integration and induce a

move to a market structure. Clemon and Row (1992) also employ transaction cost theory to argue that the use of IT, through explicit IT-based coordination, will bring about a move to the middle resulting in a network of interacting organizations. Besides, Ciborra (1993) provides a comprehensive discussion of the role of transaction cost theory in explaining IT-enable formation of teams, markets, and hierarchical structures. More recently, Kumar and Dissel (1996) employ the theory to explore the formation of IOSs, analyze the potential conflicts caused by IOSs, and propose the corresponding strategies to prevent the occurrence of conflicts.

Socio-Economics

Mitigating the Regional Difference on Information Asymmetries. In the conventional environment of international marketing, owing to the geographical distance and time constraint, the flow and acquisition of information is difficult and slow. Therefore, it has caused the difference of regions and countries in living-standard, thinking, behavior, and so on. However, the implementation of EC will accelerate the information flow and acquisition, and make it more convenient for consumers to acquire information transmitted from other places in the world. The phenomenon of product information asymmetries can be moderated by transmitting the digital products over the Internet, which makes it possible for the consumers to try out the products before purchasing them. Therefore, EC certainly mitigates the degree of information asymmetries in the international region-markets.

Change in organizational structure. The main argument of the collective school of thought is that the diffusion of any technology is a matter of social rather than individual choice. The enabling technologies of EC are pervasive not only in product transactions but also in other social attributes such as organizational structure, politics, education or culture (Armstrong et al., 1996). Large, hierarchically structured companies continue to downsize in the face of dramatic shifts from traditional corporate jobs to newly created opportunities in the burgeoning world of small businesses, entrepreneurial activities, telecommuting, and on-line marketing. Cyberspace is making it possible for small companies to take advantage of some opportunities traditional affordable only to big companies. Although starting any small business these days is as much headache as adventure, setting up a Web site and opening for business can be simpler and less expensive, with the right professional help, than setting up an equivalent retail store. Within the organization, configurations of work teams will be created and recreated to respond to the everyday challenges of markets (Hoffman et al., 1995). Installing e-mail, for example, on the computers of all members within an organization may mean that from now on members can directly communicate with the head of the organization without having to go through his or her secretary. Email facilitates communication between those at the bottom of the organizational hierarchy and those at the top, thus having a democratizing effect on organizations. This could represent a change in the communication channels within departments, causing individuals who feel threatened by the change to resist it (Markus, 1994). Relationships between sellers and customers are being altered by the spread of EC. An indirect consequence may be organizational changes within the selling firms, whether they are manufacturers, distributors, retailers, or service providers. In essence, the firm will not be a fixed conglomeration of building, offices, organizational charts, and job descriptions. This emancipates the investors from the compulsory consultation of brokers and reduces the agent's engagement to merely the execution of orders (Angehrn et al., 1997).

Change in global culture. Culture rises from geography because place is a primary shaper of the soul. Place is the character of a particular landscape as altered by human occupation. Moreover, culture is what happens when individual souls find themselves gathered and interacting in this place (Rennie, 1993). The Internet can expand our sense of shared culture by expanding our opportunities for exposure to the humanities. The world is great literature, art, music, film, and media yet to be developed will be, quite literally, at our fingertips. Cultural and multilingual issues arise with the ubiquitous nature of the Internet. Computer-mediated conferencing has facilitated the creation of virtual global communities that stand to redefine our notion of self and community. There is cause for an optimistic view regarding the development of a global village of good will. English is clearly the primary language of the Internet, and there do not appear to be any forces likely to turn the tide away from English as the standard language of choice. However, several nations are resisting allowing access to the Internet because of the dominance of English. Efforts must be make to find a way for all to the benefit from global achievement and to personalize Internet services to people with different languages and cultural backgrounds. Virtual communities could be very ill-defined in the accommodation of cultural and social norms, and yet the challenge is all the more significant because commerce on the Internet potentially must address an international marketplace. With the evolution of virtual communities, the organization as an individual operating environment may cease to exist as

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co-operative ventures become the norm and business boundaries become blurred; society will increasingly find it more difficult to retain cultural mores and restrain growth through information control.

Change in virtual education. Education is by many measures the world's potentially largest EC industry. Globalization allows new methods of packaging and delivering educational products for changing habitual domains to expand competence sets, i.e., to enrich traditional methods of knowledge acquisition and to enhance the new skills and tools needed to educate productive and creative members of the information society (Yu, 1990, 1995). Virtual education may become the norm, as some have suggested, as the least expensive way to deliver the educational products, while face-to-face teaching may turn into for the well-to-do. Instead of teaching about the use of technology, new courses are being developed to focus on the effective use of information. Telecommuting to workplace and school presents the practical promise of virtual learning. The growth of telecommuting represents a shift in the definition of workers' productivity. Most jobs now involve manipulating storable and retrievable knowledge. The result of that manipulation defines productivity. Where the work is done, or who sees it done, is of decreasing importance. Managers and workers are taught how to identify their own information needs, how to share information effectively with others, and how to make information-based decisions (Auger and Gallaugher, 1997). Universities develop course offerings involving how to search for information and use it effectively, consistent with a newly popular emphasis on lifelong learning. Also, the use of e-mail to administer a research project will likely be much more extensive in academic research on most subjects in the future. The response rate and the quick turnaround time all suggest that virtual education and training may prove valuable tools to researchers and the business community.

Effect on governmental and political transformation. Information technologies do not merely deliver sundry consumer benefits; they constitute part of a society's core political infrastructure. Information Technologies do this by establishing an intricate and pervasive network of structurally consequential political influences, opportunities, and constraints. Governments today are faced with increasing difficulty in maintaining the traditional borders that they have relied upon for political control. As these borders crumble, new political forms and arrangements are certain to evolve, in unpredictable ways. Change has become a political constant. Information technology is at the core of the current process of more global change at an ever-accelerating pace. The forms of communication that engender change (i.e., pagers, cellular phones, calling cards, fax, toll-free numbers, email, videoconferencing, and online forums), have never been so propitiously available. The dynamics of delivery and chaos in online communities bring with them promises but also potential challenges. With regard to political parties, the flirtation of more and more candidates with forming a new party or running as an "independency" is an indication of a more diverse electorate than perhaps can be truly represented by a two-party systems. It remains to be seen whether the two-party systems can maintain its hold on the political process in the presence of splintering culture and the influence of online constituencies. The threat of more divisiveness, more lobbyists, more shrillness in the national discourse, and less unity and cooperation becomes a definite possibility with the formation of specialized online forums and sites (Heilemann, 1997). The political humor and opinions have always been a key part of the political process but indexed and accessible by topic or name on the Internet, they could be more influential than ever in changing perceptions and the landscape of politics. Moreover, the shift away from reliance on centralized government solutions towards local solutions for individuals, families, and neighborhoods may do more to improve our personal lives than any amount of the national politics. Seeking local solutions is the wave of change most readily enabled by cyberspace-interdependence. Government sponsored "megasites" are more common in Asia than in the United States and reflect the Asian countries' emphasis on government-led economic development. However, government support and cooperation in allowing the free flow of trade and ideas, agreeing on issues such as data security, taxation on transactions, and infrastructure will be critical for the Internet's future expansion. Numerous issues will need to be studied: defining the roles of national governments in limiting the inflow of ideas, defining national boundaries for regulated industries.

Information management

Change in MIS. Since more services are based on maintaining customer databases and direct electronic communication links, the management information systems (MIS) will become a key to making the corporate strategic plan reality. Its success will be based on its ability to translate a service delivery strategy into an effective IT infrastructure. End-customer systems will be very demanding of MIS skills and resources. Internet user demographics projects are currently under way in different countries to collect and analyze survey data on Internet users to acquire preliminary information on

behavior, attitudes, opinions, and demographics. By taking advantage of similar survey techniques to collect updated information, information systems managers must be extremely end-user focused. The transition to an information service-driven economy also results in a different strategic focus. The industrial era notion of building competence based on manufacturing capability may become obsolete. The core competency of organizations will be increasingly founded on the ability to deliver service. This implies that many organizations need to redefine their fundamental purpose and transform from thinking about products to thinking about services and the customer's ultimate goal. In a volatile, dynamic Internet environment, there is no simple information management formula guaranteeing success. A willingness to take timely advantage of relevant Internet technology and applications and a consistent emphasis on product development are all needed in ensuring MIS achievement.

WWW challenges. EC is emerging as an increasingly important way for organizations to reach potential customers. However, EC presents many challenges to the organizations that implement it. It has been hailed as a means for companies to improve productivity and cash flow, decrease inventory, and enhance customer relations, but empirical research has yet to confirm that organizations view it in this positive fashion. An increasingly Internet literate consumer will be an important factor in the support of electronic marketing, but this does not mean that the trend is strong enough yet to ensure success. Consumer demand for these services is uncertain, to say the least. Some believe that the Internet shopping mall has a long way to go before it reaches its full potential (Lederer et al., 1997). Although considerable work is being done to improve EC, the technology is still too immature to bank on. Current interest in EC also has not translated into extensive sales across the industries. Moreover, establishing organizations of EC operations would require enormous capital and cooperation between participants. Responsibilities to consumers include not only guarantees of privacy and security but also customer service and protection against fraudulent claims and deceptive advertising. The impact of the emergence of EC to having organizations' products and services delivered directly to business and customer is for the time being uncertain. It depends heavily on customer acceptance, telecommunications bandwidth availability and costs, and network security development. Some companies even contemplate cutting back on their EC presence, as they can see short-term benefit of doing so. Education and training become cheaper through electronic education services on the Internet, and technological skills and productivity in the electronic marketplace will level off among workers in many types because the difference between high-tech and low-tech professionals is smaller than in physical markets. For these reasons, the income gap is expected to narrow as the Internet grows. Some economics issues of concerns include a shift from labor-intensive jobs to information-intensive jobs requiring new skills and training, upholding intellectual property, increasing the number of business transactions that are handled through mail and personal travel, and infrastructure support for electronic payment and brokerage systems (Quinn, 1992).

BUILDING A HIERARCHY STRATEGY MODEL FOR EVALUATING THE INTERNATIONAL ELECTRONIC MARKETING

In recent, Kalakota and Whinston (1996) hold that the information infrastructure is composed of information superhighway, multimedia content and network publishing, the messaging and information distribution, and common business services infrastructures. The common business services infrastructure consists of services for security, authentication, electronic payment, directories/catalogs and so on.

Building a Hierarchy Strategy model

We apply the PATTERN (Planning Assistance Through Technical Evaluation of Relevance Number) method and concept (NASA PATTERN, 1965,1966; Tzeng, 1977; Tzeng and Shiau, 1987) to build a hierarchy strategy system for evaluating international electronic marketing strategies. Its analytical procedures include three steps: (1) scenario writings, (2) building a relevance tree, and (3) evaluation. In this subsection, we focus on scenario writings and building a relevance tree. Scenario writings is based on catching the habitual domain (Yu,1985, 1990, 1995), i.e., past understanding of problems, experience, knowledge and information derived from brainstorming techniques discussed in previous sections to probe the effects of catching the optimal trends of the international electronic marketing strategy (goal level). Then the question becomes how can this goal be achieved on the effects. We can consider the problem from three viewpoints: (1) business development (information providers, i.e., information investors), (2) customers (information users), and (3) socio-economics. According to the literature reviews and experience, relevance trees are used to create hierarchy strategies for catching the optimal trends of the international electronic marketing strategy using scenario writings. The elements (nodes) of relevance trees are "a relevance set" composed of statements derived from "goal" (high level) through

aspect, objective, policy or strategic planning, to the implementation (lower level). Elements (nodes) of relevance trees are defined and identified in hierarchy strategies through brainstorming concepts; they are located at every level from the interaction feedback procedure of high to low levels (top down) and from the low level integrated up to the high levels (bottom up). Such a system structure institutes evaluation hierarchy strategies for catching the optimal trends of the international electronic marketing strategies as shown in Fig. 1 (The international electronic marking strategies will be described in the next section).

A New Paradigm of Electronic Marketing Strategies of the Information Service Industry

As discussed earlier, the development of EC implies changes in the international marketing environment. Therefore, a new paradigm for electronic marketing strategies of the information service industry deserves further analyses of positioning, consumer loyalty, advertising, marketing skills, distribution, brand, differentiation, product development, product mix, packaging, customer service, pricing, electronic payment systems, and marketing research shown as Table1.

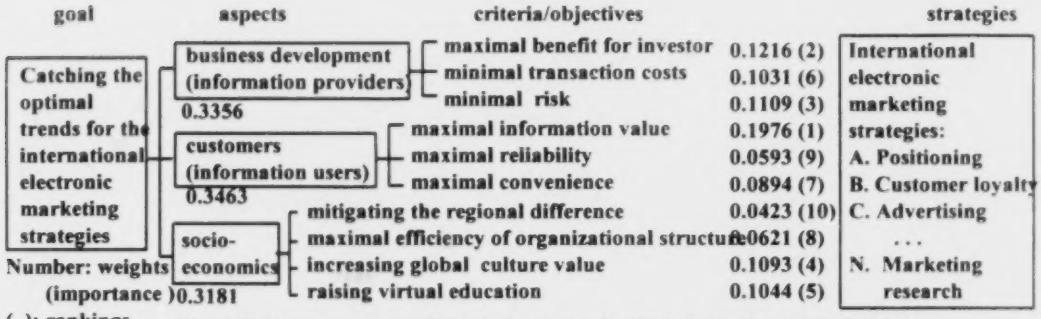


Fig. 1 Relevance system of hierarchy strategies for information service industry

TABLE 1
ELECTRONIC MARKETING STRATEGIES AND TRENDS OF INFORMATION SERVICE INDUSTRIES

International marketing issues	Electronic marketing strategies and trends
A. Positioning	The result of market positioning evaluation can be divided into four quadrants, including "investment (growth)", "strengthen the company's edge of e-commerce (be careful)', "don't enter (safety)" and harvest (exploration)".
B. Customer loyalty	By creating healthy on-line communities, business will be able to build customer loyalty to a degree that today's marketers can only dream of and, in turn, will generate strong economic return (Armstrong and Hagel, 1996).
C. Advertising	EC allows marketers to collect a large amount of customers' personal data and consumption behaviors from the Web to construct their own comprehensive databases, which provide a great diversity of promotion, advertising, and discount policies, depending on consumers' characteristics and product preferences

TABLE 1
(continued)

D. Marketing skills	Marketing personnel must enlarge their domain knowledge, learn how to take advantage of information technology to attract customers and increase the customer loyalty, and realize the strategic of EC on international marketing.
E. Distribution	The distribution strategy in information service industries no longer puts emphasis on the selection of physical distribution channels and store locations, but on that of intermediaries providing value-added and consulting services.
F. Brand	The development of brand identity is critical to information service providers because brand identity could strengthen consumers' trust in their digital products and on-line transaction procedures.
G. Differentition	Due to numerous information content, world-wide consumers, lower communication and transaction costs, small companies offering specialized niche products should be able to find the critical mass of customers necessary to succeed.
H. Product development	Developers of information products can take advantage of the low-cost communication of the Internet and Intranet to exchange product-related information with each other and improve their management efficiency of project schedules, budgets and human resources.
I. Product mix	The information service industries in EC not only adopt the personalization policy providing consumers with various information, but also undertake the customization policy allowing consumers to select and bundle their desired product mixes, depending on their preferences, leading to the prevalence of micromarketing.
J. Packaging	Information interfaces of Web sites which become the sole communication channels for on-line companies and consumers will have a great influence on consumers' will to browse Web sites and purchase products.
K. Customer service	The customer service strategy of information products in the EC environment is to provide customers with global, instantaneous, interactive, and personalized services.
L. Pricing	To tailor the product to a variety of markets, information service providers should design various pricing policies in accordance with the content mix, transmitted speed, accuracy, priority, and other related services of information products.
M. Electronic payment	Due to the face-to-face communication in the on-line marketing circumstances, where all the payment and settlement procedures are carried out on the Internet, the security and convenience of electronic payment systems have a great influence on consumers' desires to make transactions Web sites.
N. Marketing research	The Internet, a new media with fast information distribution and feedback, expands the acquisition channel of market data and decreases the difficulty and cost of conducting international marketing research.

Table 1 is provided the evaluators (experts) as a considering base for rating scores of the effects on each objective from three aspects: information providers, information users, and socio-economics (see Fig. 1). We propose one method for evaluating the electronic marketing strategies in the international information service industry described in next section.

EVALUATING THE HIERARCHY SYSTEMS FOR ELECTRONIC MARKETING STRATEGIES

Traditional evaluation methods usually take the minimum cost or the maximum benefit as their only single index of measurement (Tzeng and Tsaur, 1993; Tsaur et al., 1997), but in an increasingly complex and diversified decision-making environment, this approach may sacrifice too much valuable information in the process. Thus, in this study we propose a multiple criteria decision-making (MCDM) method to evaluate the hierarchy systems for electronic marketing strategies. The information service industry is a newly-risen and quickly-changing industry judging present trends. As result, the effects of electronic marketing strategies and trends on each objective are uncertain. The concept of perceived objectives/criteria (such as risk, information value, reliability, convenience, regional differences, culture, etc.) most often used by researchers defines vague objectives in terms of the consumer's or producer's perceptions both of the

uncertainty and the magnitude of the possible adverse consequences. Since the extent to which vague objectives/criteria are captured by research is itself not known with certainty, the evaluation is conducted in an uncertain, fuzzy environment. During the process of evaluation, indices of objective measurement cannot be determined while the expert evaluators are unclear about objective measurement, since this could make the values imprecise and create too large an allowance for error. Therefore, in this study we propose a fuzzy multiple objectives/criteria evaluation method for evaluating the effects of electronic marketing strategies on the information service industry. The processes of evaluating the hierarchy strategies are introduced in the next two sections.

The Processes of Evaluating the Hierarchy Strategies

The processes of evaluating the hierarchy strategies includes three steps: (1) assessing the weights (relative importance grade) of each strategic item, (2) getting the performance value of each strategic item from the sense of experts, and (3) evaluating the strategic items.

Evaluating the weights for the hierarchy relevance system. The AHP weighting (Saaty, 1977, 1980) is mainly determined by the evaluators who conduct pairwise comparisons, so as to reveal the comparative importance of two criteria. If there are n evaluation criteria/objectives (items or nodes), then the decision-makers have to conduct $C(n,2)=n(n-1)/2$ pairwise comparisons. Furthermore, the relative importance derived from these pairwise comparisons allows a certain degree of inconsistency within a domain. Saaty used the principal eigenvector of the pairwise comparison matrix derived from the scaling ratio to find the comparative weigh among the criteria (as aspects and criteria/objective, see Fig. 3) of the hierarchy systems for electronic marketing strategies.

Suppose that we wish to compare a set of n criteria/objectives in pairs according to their relative importance (weights). Denote the criteria/objectives by $C_1, C_2, \ldots, C_n$ and their weights by $w_1, w_2, \ldots, w_n$. If $w=(w_1, w_2, \ldots, w_n)^T$ is given, the pairwise comparisons may be represented by a matrix A of the following formulation:

$$(A-\lambda_{\max} I)w=0 \qquad (1)$$

Equation 1 denotes that A is the matrix of pairwise comparison values derived from intuitive judgment (perception) for ranking order. In order to find the priority eigenvector, we must find the eigenvector w with respective $\lambda_{\max}$ which satisfies $Aw=\lambda_{\max}w$. Observing from intuitive judgment for ranking order to pairwise comparisons to test the consistency of the intuitive judgment that since small changes in elements of matrix A imply a small change in λ_j ($\sum_{j=1}^{n}\lambda_j = tr(A)$ = sum of the diagonal elements = λ_j, therefore only one of λ_j, we call it $\lambda_{\max}$, equals n, and if $\lambda_j = 0$, then $\lambda_j \neq \lambda_{\max}$), the deviation of the latter from n is a measure of consistency, i.e., C.I. = $(\lambda_{\max}-n)/(n-1)$, the consistency index (C.I.), as our indicator of "closeness to consistency." In general, if this number is less than 0.1, we may be satisfied with our judgment (refers to Saaty, 1977, 1980).

In this problem, the group decision-makers should at least need to include three groups (three aspects in Fig. 3): (a) information providers (managers of information producer), (b) information users (customers), (c) representers of socio-economics (socio-economic researchers).

Getting the Performance Value

The evaluators (experts in electronic marketing) choose a score (performance value) for each electronic marketing strategy based on their subjective (intuitive) judgment. This way the methology for estimating the achieving level of each criterion/objective in each electronic marketing strategy and future tends of the information service industries can use the methods of fuzzy theory for treating the fuzzy environment. Since Zadeh introduced fuzzy set theory (Zadeh, 1965), and Bellman and Zadeh (1970) described the decision-making method in fuzzy environments, an increasing number of studies have dealt with uncertain fuzzy problems by applying fuzzy set theory. The application of fuzzy theory to get the performance values can be described as follows:

Fuzzy number. Fuzzy numbers are a fuzzy subset of real numbers, and they represent the expansion of the idea of the confidence interval. According to the definition of

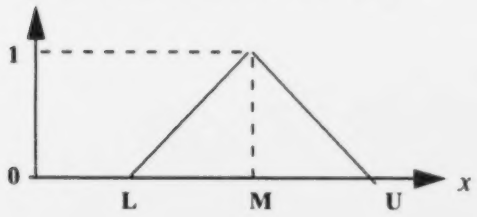
Dubois and Prades (1980), the fuzzy number $\tilde{A}$ is a fuzzy set, and its membership function is $\mu_{\tilde{A}}(x)$: $R \rightarrow (0,1)$ and Is enshrined with the following characteristics.

(i) $\mu_{\tilde{A}}(x)$ is a continuos mapping from to the closed interval 0,1; (ii) $\mu_{\tilde{A}}(x)$ is a convex fuzzy subset; (iii) $\mu_{\tilde{A}}(x)$ is the normalization of a fuzzy subset, which means that there exists a number x_0 that makes $\mu_{\tilde{A}}(x_0) =$.

Those numbers that can satisfy these requirement will then be called fuzzy numbers, and the following is explanation for the characteristics and operation of the triangular fuzzy number as shown in Equation (2) and Figure 2.

$$\mu_{\tilde{A}}(x) = \begin{cases} (x-L)/(M-L), & L \le x \le M \\ (U-x)/(U-M), & M \le x \le U \\ 0, & \mu_{\tilde{A}}(x) \quad otherwise \end{cases} \qquad (2)$$

FIGURE 2
THE MEMBERSHIP FUNCTION OF THE TRIANGULAR FUZZY NUMBER



According to the characteristics of triangular fuzzy numbers and the extension principle put forward by Zadeh (1965), the algebraic operation of the triangular fuzzy number $\mu_{\tilde{A}_1}(x) = (L_1, M_1, U_1)$ and $\mu_{\tilde{A}_2}(x) = (L_2, M_2, U_2)$ can be displayed as follows:

- Addition of a fuzzy number

$$(L_1, M_1, U_1) \oplus (L_2, M_2, U_2) = (L_1 + L_2, M_1 + M_2, U_1 + U_2) \qquad (3)$$

- Multiplication of a fuzzy number $\otimes$

$$\text{(i)} \quad (L_1, M_1, U_1) \otimes (L_2, M_2, U_2) = (L_1 L_2, M_1 M_2, U_1 U_2), L_1 \ge 0, L_2 \ge 0 \qquad (4)$$

(ii) Any real number k

$$k \otimes \mu_{\tilde{A}}(x) = (k,k,k) \otimes (L, M, U) = (kL, kM, kU) \qquad (5)$$

-Subtraction of a fuzzy number $-$

$$(L_1, M_1, U_1) - (L_2, M_2, U_2) = (L_1 - U_2, M_1 - M_2, U_1 - L_2) \qquad (6)$$

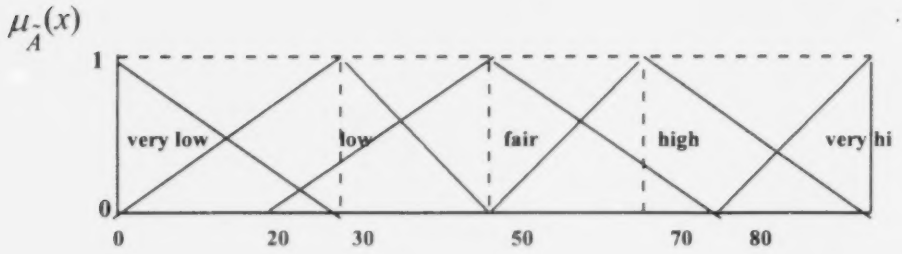
-Division of a fuzzy number $\div$

$$(L_1, M_1, U_1) \div (L_2, M_2, U_2) = (L_1 / U_2, M_1 / M_2, U_1 / L_2), L_1 \ge 0, L_2 \ge 0 \qquad (7)$$

Linguistic variable. According to Zadeh (1975), it is very difficult for conventional quantification to express reasonably those situations that are overtly complex or hard to define; thus the notion of a linguistic variable is necessary in such situations. A linguistic variable is a variable whose values are words or sentences in a natural or artificial language. For example, the expressions of criteria/objectives as "risk of information providers," "information value, or reliability, or convenience of information users," "difference level of regions," "efficiency of organizational structure," "global culture value" and so on all represent a linguistic variable in the context in these problems (see Fig. 1). Linguistic variables may take on effect-values such as "very high (very

good)," "high (good)," "fair," "low (bad) ," "very low (very bad)." The membership functions of the effect-values can be indicated by triangular fuzzy numbers, which are as shown in Fig. 3. The use of linguistic variables is rather widespread at present, and the linguistic effect-values of electronic marketing strategies found in this study are primarily used to assess the linguistic ratings given by the evaluators. Furthermore, linguistic variables are used as a way to measure the achievement of the performance value for each criterion/objective.

FIGURE 3
THE MEMBERSHIP FUNCTION OF THE FIVE LEVELS OF LINGUISTIC VARIABLES



Evaluating Electronic Marketing Strategies

Bellman and Zadeh (1970) were the first to probe the decision-making problem in a fuzzy environment, and they heralded the initiation of fuzzy multiple criteria decision-making (Fuzzy MCDM). Our study uses this method to evaluate the electronic marketing strategies, and ranks it for each strategy. The method and procedures of Fuzzy MCDM theory are as follows:

Measuring criteria/objectives. Using the measurement of linguistic variables to demonstrate the criteria/objectives performance (effect-values) by expression such as "very high," "high," "fair," "low," "very low," the evaluators are asked to make their subjective judgments, and each linguistic variable can be indicated by a triangular fuzzy number (TFN) within a range of 0-100. Also the evaluators can subjectively assign their personal weights to the linguistics variables.

Let E_{ij}^{k} indicate the fuzzy performance value of evaluator k toward strategy i under criterion/objective j, and let the performance of the criteria/objectives be indicated by the set S, then,

$$E_{ij}^{k} = (LE_{ij}^{k}, ME_{ij}^{k}, UE_{ij}^{k}), \ j \in S \tag{8}$$

Since the perception of each evaluator varies according to the evaluator's experience and knowledge, and the definitions of the linguistic variables vary as well, the study uses the notion of average value so as to integrate the fuzzy judgment values of evaluators, that is,

$$E_{ij} = (1/m) \odot (E_{ij}^{1} \oplus E_{ij}^{2} \oplus \ldots \oplus E_{ij}^{m}) \tag{9}$$

The sign $\odot$ denotes fuzzy multiplication, the sign denotes fuzzy addition. E_{ij} is the average fuzzy number of the judgment of the decision-maker, and it can be displayed by a triangular fuzzy number as follows:

$$E_{ij} = (LE_{ij}, ME_{ij}, UE_{ij}) \tag{10}$$

The preceding end-point values

$$LE_{ij} = \frac{1}{m}\left(\sum_{k=1}^{m} LE_{ij}^{k}\right), ME_{ij} = \frac{1}{m}\left(\sum_{k=1}^{m} ME_{ij}^{k}\right), \text{ and}$$

$$UE_{ij} = \frac{1}{m}\left(\sum_{k=1}^{m} UE_{ij}^{k}\right)$$

can be solved by the method introduced by Buckley (1985).

Fuzzy synthetic decision. The weights of the criteria/objectives of electronic marketing as well as the fuzzy performance values (effect-values) have to be integrated by the operation of fuzzy numbers so as to be

located at the fuzzy performance value (effect-value) of the integral evaluation, which is one of the procedures of fuzzy synthetics decision-making. According to the weight w_j derived by AHP, the weight vector can be obtained, and the fuzzy performance matrix of each of the strategies can also be obtained from the fuzzy performance value of each strategy under criteria/objectives, that is,

$$w=(w_1,\ldots,w_j,\ldots,w_n)^t \tag{11}$$

$$E=(E_{ij}) \tag{12}$$

From the weight vector and fuzzy performance matrix , the final fuzzy synthetic decision matrix is,

$$R= \ 0 \tag{13}$$

The sign "0" indicates the operation of the fuzzy numbers, including fuzzy addition and fuzzy multiplication. Since the operation of fuzzy multiplication is rather complex, it is usually it is denoted by the approximate multiplied result of the fuzzy multiplication and the approximate fuzzy number , of the fuzzy synthetic decision of each strategy. The expression then becomes,

$$R_i=(LR_i,MR_i,UR_i),\ \forall i \tag{14}$$

where $$LR_i=\sum_{j=1}^{n} LE_{ij}*w_j \tag{15}$$

$$MR_i=\sum_{j=1}^{n} ME_{ij}*w_j \tag{16}$$

$$UR_i=\sum_{j=1}^{n} UE_{ij}*w_j \tag{17}$$

Ranking the strategies (fuzzy number). The result of the fuzzy synthetic decision reached by each strategy is a fuzzy number. Therefore, it is necessary that the nonfuzzy ranging method for fuzzy numbers be employed during the comparison fof the strategies. In other words, the procedure of defuzzification is to locate the Best Nonfuzzy Performance value (BNP). Methods of such defuzzified fuzzy ranking generally include mean of maximal (MOM), center of area (COA), and a-cut, three kinds of method (Zhao and Govind,1991; Teng and Tzeng, 1996). To utilize the COA method to find out the BNP is a simple and practical method and there is no need bring in the preferences of any evaluators. For those reasons, the COA method is used in this study.

The BNP value of the fuzzy number R_i can be found by the following equation:

$$BNP_i=[(UR_i-LR_i)+(MR_i-LR_i)]/3+LR_i,\ \forall i \tag{18}$$

According to the value of the derived BNP, the evaluation of each electronic marketing strategy can then proceed.

An Example and Discussions

In order to show the practicability and usefulness of this research, we give an example. The processes of evaluating the electronic marketing strategies can be expressed as follows:

Evaluating the criteria/objectives weights. We find the weights (importance) attributed to each criterion/objective by the following three decision-making groups: managers of producers (information providers), customers (information users, and socio-economic researchers. The criteria weights are shown as Table 2.

TABLE 2
THE CRITERIA WEIGHTS FOR EVALUATING ELECTRONIC MARKETING STRATEGIES

aspects and criteria/objectives	weights	total weights (w_j)
Information providers	0.3356	
maximal benefit for investor	0.3624	0.1216 (2)
minimal transaction costs	0.3071	0.1031 (6)
minimal risk	0.2583	0.1109 (3)
Information users	0.3463	
maximal information value	0.5705	0.1976 (1)
maximal reliability	0.1712	0.0593 (9)
maximal convenience	0.2583	0.0894 (7)
Socio-economics	0.3181	
mitigating the regional difference	0.1329	0.0423 (10)
maximal efficiency of organization structure	0.1952	0.0621 (8)
increasing global culture value	0.3438	0.1093 (4)
raising virtual education	0.3281	0.1044 (5)

Parentheses ( ) denote the order of importance (weight) of each criterion/objective.

Estimating the performance matrix. The evaluators can define their own individual range for the linguistic variables employed in this study according to their subjective judgments within a scale of 0 -100. Table 3 shows the degree of variation in their definitions of the linguistic variables. Thus, this study can employ the method of average value to integrate the fuzzy judgment values of different evaluators regarding the same evaluation criteria/objectives. In other words, fuzzy addition and fuzzy multiplication can be used to solve for the average fuzzy numbers of the performance values under each evaluation/objective shared by the evaluators for the fourteen electronic marketing strategies (shown as Table 4).

TABLE 3
THE SUBJECTIVE PERCEPTION OF EVALUATORS OF THE FIVE LEVELS OF LINGUISTIC VARIABLES

Evaluators	very low	low	fair	high	very high
1	(0, 0, 21)	(18, 31, 44)	(40, 48, 56)	(55, 69, 82)	(80, 100, 100)
2	(0, 0, 40)	(40, 50, 60)	(60, 65, 70)	(70, 80, 90)	(90, 100, 100)
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
m	(0, 0, 25)	(20, 30, 40)	(35, 40, 45)	(50, 60, 70)	(80, 100, 100)

Ranking the electronic marketing strategies. From the criteria weights obtained by AHP and the fuzzy performance values of each criterion, the final fuzzy integrated decision can then be conducted. After the fuzzy integrated decision can be conducted and subsequently the nonfuzzy ranking method can be employed, finally the fuzzy numbers will be changed into nonfuzzy values. Though there are methods to rank these fuzzy numbers, this study can use COA to find out the BNP value which is used to rank the electronic marketing strategies of each strategy: N $\succ$ H $\succ$ E $\succ$ B $\succ$ D $\succ$ C $\succ$ K $\succ$ J $\succ$ I $\succ$ M $\succ$ G $\succ$ A $\succ$ F. Our illustrated example is based on the results of a generalized model making a number of our research group to explain the concept of this method for evaluating the electronic marketing strategies in fuzzy environment. From the results of practical applications in

evaluating the electronic marketing strategies, the proposed method makes good evaluation and appears to be the most appropriate in fuzzy environment.

CONCLUSIONS

Marketers all over the world agree that EC will have major impact on the way firms do business. What changes will occur is hard to predict as the Internet is in a phase of rapid growth and constant change. This paper has looked at the prescriptions given in the literature as to how EC willinfluence the scope, style, and marketing of products across national boundaries. This paper has particularly focused on the electronic marketing implications for the strategies and trends of the information service industry. As a company grows, management may find it necessary to reconfigure both its internal and external structures as part of its strategic response. That means that marketing as well as other environmental issues all need to be considered when evaluating the EC applications. This study has analyzed the changes in the international marketing environment and then presented a conceptual framework to expound the relationships among the information infrastructure, EC, the international marketing environment, and the hierarchy fuzzy MCDM method for international marketing. This paper has discussed the impact of EC on several international marketing issues, including positioning, consumer loyalty, advertising, marketing skills, distribution, brand, differentiation, product development, product mix, packaging, consumer service, pricing, electronic payment and marketing research in the information service industry.

Lastly, our illustrated example is based on the results of a generalized model evaluating the electronic marketing strategies in fuzzy environment. From the results of practical applications in evaluating the electronic marketing strategies, the proposed method is appropriate and appears to be ideal for a fuzzy environment.

Given that this a first attempt to formally model the effects of the Internet on international marketing strategies by using fuzzy MCDM, we believe that the insights gained herein are a significant theoretical contribution to the literature and lay the groundwork for future research. In order to render a more complete and pragmatic characterization of the EC's effects on electronic marketing strategies, the evaluation hierarchy systems will need to be examined at a lower level to catch the actual phenomena and the implementation strategies. A number of extensions would be clearly be interesting to explore, including the use of survey design and group decision-makers.

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